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ABSTRACT

A study examined what happened when a group of adult students read a hypertext for the goal of answering specific questions. Subjects, 30 students enrolled in an upper-division psychology course at a state university in the northwestern United States, read a binary tree-structured hypertext to answer three two-part questions on the topic of cosmology. Data consisted of responses to the questions, traversal paths, time spent in hypertext nodes, and time spent at the "questions" screen. Results indicated that: (1) most readers found the two-part questions difficult to answer, although more successful readers chose important hypertext nodes more often and read them relatively longer than unsuccessful readers; (2) questions posed to the hypertext readers differed in difficulty as a direct result of the complexity of their traversal paths; (3) readers who adopted a depth-first search strategy were more successful than readers who used a breadth-first search strategy; and (4) readers who reinspected their responses were more likely to be successful. Hypertext may be beneficial as a writing medium wherein readers respond to writers by writing within the format of a hypertext. (Six figures representing hypertext screens, and two figures and two tables of data are included; 19 references are attached.) (RS)

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Goal-Directed Reading of Complex, Embedded Hypertexts: Effects of Goal and Interest on Search Strategies and Selective Attention

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Running head: HYPERTEXT COMPREHENSION

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Abstract

When adults read a hypertext for the goal of answering specific questions they are mostly unsuccessful Hypertext is a novel text structure for most readers who may find it difficult to use tradiational text strategies. Thirty adults read a binary-tree-structured hypertext to answer three two-part questions on the topic of cosmology. Results confirmed the hypotheses: (a) Successful readers chose only important nodes to read, (b) questions that required more node traversal were more difficult to answer, and (c) successful and unsuccessful readers had different hypertext reading strategies. Although, most readers found the two-part questions difficult to answer, the more successful readers chose important hypertext nodes more often and read them relatively longer than unsuccessful readers. In addition, questions posed to the hypertext readers differed in difficulty as a direct result of the complexity of their traversal paths. Readers who adopted a depth-first search strategy were more successful than readers who used a breadth-first search strategy and readers who resinspected their responses were more likely to be successful. Comprehention may fail for readers who are unfamiliar with the domain or structure of a hypertext. However, there are specific strategies that could be taught including knowing and using the hypertext structure, searching deeply before giving up on a search path, and reinspecting one's response to see if it answers the question. Hypertext may be beneficial as a writing medium wherein readers respond to writers by writing within the format of a hypertext.

Effects of Question Complexity and Reader Strategies on Adults' Hypertext Comprehension

An impetus to read and write text in new ways is being fueled by smaller, faster, and less expensive computers. Most of the new ways to read and write text can be subsumed under the label hypertext (cf. Barrett, 1989), which refers to the notion that texts and portions of texts can be linked together by common elements. In complex forms, hypertext can link together media elements (e.g., sound and pictures) as well as text and subtext (e.g., words and their definitions). This report is concerned with the most basic elements of hypertext: linking texts based on key words found within expository text.

Unlike traditional text, hypertext can be controlled and even extended by the reader (Barrett, 1991; Computers and the Human Conversation, 1991; Marchionini, 1988). If readers are to have more control of text and the ability to extend text, then it is important that writers know more about what readers do when reading hypertext. What do readers do when asked to read a physics hypertext, and answer questions about Grand Unification Theory or gravity? Are the readers able to select only the important information to read? Are some questions easier than others? Can we predict what the questions will be? Do readers who have good responses to questions read in the same manner as those who have poor responses? What follows is a report of a study that sought answers to these questions.

Although the literature on hypertext structure is meager, the literature on traditional expository text states that well-structured text is easier to read than ill-structured text (Garner & Gillingham, 1987; Meyer, Brandt, & Bluth, 1980; Taylor & Samuels, 1983; Williams, Taylor, & Ganger, 1981). A well-structured text is built from well-structured paragraphs that have a topic sentence as the first sentence (Meyer, Brandt, & Bluth, 1980). Subsequent sentences support the topic sentence (Williams, Taylor, & Ganger, 1981). Pairs of sentences are linked by lexical ties (Taylor

& Samuels, 1983). This structure can be the building block of larger texts and, one presumes, hypertexts. Next, I review the existing research on hypertext.

Hypertext is a developing concept that was, perhaps, first thought of by Bush (1945), who envisioned a text that was organized like the human mind. Others have made this idea more concrete (Engelbart, 1963; Nelson, 1980) until presently, there are many examples of exposition that could be termed hypertext (Barrett, 1989; Marchionini, 1988). Although all hypertexts have nodes of text linked on some basis, there are many different forms of hypertext.

One form of hypertext assumes that nodes are records in a database and links are fields represented by each record. This view of hypertext is the most constrained. Much less constrained are hypertexts created from linking every important word in each text node to the same words in every other node (Shneiderman, 1989). In this type of hypertext a reader can jump to another node simply by choosing a word in the text being read. Unfortunately, performing a jump like this several times in succession can be disorienting to a reader familiar with traditional linear text. Disorientation is so common that a word to describe where one is when lost has been invented: hyperspace. Most examples of hypertext structure are in between these two extreme examples (Brockmann, Horton, & Brock, 1989). For instance, a table or grid structure reduces the number of possible links to the rows within a column. To get to a new column, one has to go to the top of the grid (Level 0). An inverted tree structure allows more flexibility at lower levels (twigs and leaves) than a grid, but is still constrained by having to go to Level 0 to go to a different category (limb).

Hypertext documents can help readers find information by allowing them to traverse multiple text nodes within the same computer-based environment. This environment may also cause confusion. For instance, readers can get lost by traversing too far from important information. Gray and Shasha (1989) found that some readers reported being wary of using some of the hypertext features of a hypertext environment (NetBook) because they were afraid of getting lost. Readers can also fail to find information that they are looking for because their search words are not linked to anything or are linked differently than expected (Gray & Shasha, 1989; Weyer, 1982). When searching a hypertext to answer specific questions, according to Weyer (1982), readers usually search the hypertext for important words and phrases from the question. If this fails, they may attempt variations of the words or phrases from the question. If this tactic also fails, they may read and reread through the same material whether it is helpful or not. Finally, readers may select unimportant words of a question as a basis for searching the hypertext, which generally leads to search failure. These tactics are simplistic and can be compared to a list of unsuccessful general-problem-solving strategies suggested by Qin and Simon (1990): Search broadly, but not systematically; search only the first step of each strategy without keeping track of distinguishing characteristics among strategies; examine only easy strategies without reflection; and continually reinspect previously rejected strategies.

As an alternative to the unsuccessful search strategies just described, one could envision successful strategies. For instance, one could take the unsuccessful general-search strategies outlined by Qin and Simon (1990) and make them successful. This would entail searching deeply and systematically; searching multiple steps and keeping track of each of them; selecting important, not just easy, information to search; and searching information only once. This set of search strategies might be reduced to a strategy that is often used to search computer-based tree structures; the depth-first search. A depth-first search implies a deep, systematic, and exhaustive search through a tree structure in which already-seen nodes are marked so they are not visited again. However, the depth-first search lacks selectivity. It searches every node on every limb in an invariant order. The strategy could be improved if it were combined with a selection strategy that made some limbs more important than

others and those important limbs were searched first.

Another search strategy (Guthrie & Mosenthal 1987), proposes a four-part model of search. The parts of the model are goal formation, category selection, extraction of information, and integration of information. Guthrie has also applied the model to three categories of text that have approximately the same information: exposition, tables, and directories (Guthrie & Britton, 1989). Category selection was faster when reading exposition than when reading tables or directories, but just the reverse was true for extraction of information, where tables and directories were faster than exposition. In terms of a depth-first search strategy, extraction from leaves combined with good category selection from top-level nodes and limbs makes for a successful search strategy. Again, what is successful is a depth-first search combined with selectivity.

Successful searching of text depends on the difficulty of questions asked of the reader as well as the search strategies she employs. Gray and Shasha (1989) found significant differences in readers' ability to answer the five questions that were posed to them. Two of the questions were answered more quickly and more accurately by readers of paper-based text than either of two computer-based texts. When questions were more complex, however, paper-based searching was less efficient. The difficulty of a question depends, in part, on the number of places in a text one must read to find an adequate answer. For instance, one would expect many readers to find an answer when it could be found in a single node or in two adjacent nodes, but as nodes become further apart or more nodes must be found, fewer readers would be expected to find an answer.

This report describes what happens when a group of adult students read a hypertext for the goal of answering specific questions. The hypotheses included: (a) Successful readers will choose only important nodes to read, (b) questions that require more node traversal will be more difficult to answer, and (c) successful and unsuccessful readers will have different hypertext reading strategies.

Method

Subjects

Subjects were 30 students enrolled in an upper-division psychology course at a state university in the Northwestern United States. Subjects participated in the study as a part of their coursework. All subjects had used computers previously, but none had previously read hypertext.

Materials

A hypertext was created for this study based on a five-paragraph linear text (Author) about Stephen Hawking's theory of cosmology and the crippling disease that he has: amyotrophic lateral sclerosis (Lou Gehrig's Disease). From the linear text, a hypertext was generated following specific criteria that created a tree structure: Each paragraph of the original text (Level 0) had two links to text nodes (Level 1), each of these subsequent nodes had two more links to nodes (Level 2), each node was at least one complete paragraph and covered at least one screenful of space. The decision for this design was made based on the following criteria: Make the number of links per node a small number, create a tree structure because it is easier to traverse than a web (Brockmann, Horton, & Brock, 1989), have at least two levels to the structure to add node-traversal complexity, and give the appearance of more than one screenful of text (even if that is not the case) to ensure the appearance of similar inspection possibilities for each node.

The content of the hypertext was extracted from Hawking's book (1988), other texts about cosmology and amyotrophic lateral sclerosis, and news reports in magazines and newspapers. Once a draft of the content of the hypertext was written, two colleagues (one in English and one in Reading) read the draft for clarity, machanics, and structure. Based on the advice of these experts, the paper-based hypertext was revised to increase cohesion within text nodes. The paper-based hypertext was entered into a computer file, links were constructed between text nodes, and a special node was added to display questions pertaining to the text (described next).

Six student volunteers then read the

computer-based hypertext and answered the questions. Based on the suggestions of these students, small changes were made to the computer interface to increase visual clarity and to the questions to increase logical clarity. The final hypertext had five paragraphs at Level 0. Each of the five paragraphs had two Level-1 nodes and each of these Level-1 nodes had two Level-2 nodes. The total number of Level-1 and Level-2 nodes was 30. Table 1 lists the titles of each Level-1 and Level-2 node. Each title was highlighted in the text of a higher-level node. For instance, the Level-1 node "Grand Unification Theory" was highlighted in a Level-0 paragraph and the Level-2 node "Quantum Mechanics" was highlighted in the text of the Level-1 node "Grand Unification Theory."

Place Table 1 about here

Three two-part questions were constructed that differed systematically on the number of traversals necessary to find a complete answer. Question 1 was designed to be the easiest of the three questions due to two factors; it had a direct linear traversal path from levels 0-2 and a duplicate path to one of the two nodes (Quantum Mechanics). The duplicate path allowed two opportunities to find one part of the answer. Question 2 was designed to be the most difficult because its traversal path included two different Level 1-2 paths from the same level-0 node. Question 3 was designed to be of intermediate difficulty. Its path included two level-2 nodes from the same level-1 node.

Procedure

Student subjects volunteered for 1-hr slots during a single day in lieu of their regular class period. During any one slot of time, from 1 to 6 subjects participated. Subjects were told that they would be reading a text and should report to a classroom, which was in the same building as their regular classroom. The instructor/investigator monitored the procedure for every time slot. Instructions were read from a script to ensure uniformity of information presentation.

During the first 10-15 minutes of a time-slot, subjects reviewed the computer keyboard, mouse, and screen image. Subjects practiced using the hypertext interface by reading a sample hypertext and answering practice questions. When all members of a group demonstrated that they could perform the procedures, they were instructed on how to proceed to the experimental hypertext. During one session, two subjects appeared to be "ready," but needed extra help after the rest of the group was already proceeding. Subjects read and answered questions until they were finished or until it was the end of the hour.

The hypertext software was divided into Questions and Hypertext. Questions was a single screen with various windows that displayed the three questions one at a time in random order and provided space for answering them (see Figure 1). A subject could reject any question in favor of another by clicking a button. This feature was meant to provide information on metacognitive aspects of subject's question selection. Choosing a question to answer would be part of goal formation (Guthrie & Mosenthal, 1987). Modifications to responses could be made at any point during a session, which would correspond to integration in the Guthrie and Mosenthal (1987) model. The software kept track of these revisions. Questions also acted as a "home base" to which subjects could immediately return when in Hypertext, described next, by clicking a button.

Place Figure 1 about here

Hypertext had embedded links signalled by words or phrases in bold face (see Figure 2). One had only to click on the bold-face type to traverse to a text node represented by it. To retrace one's steps, one clicked on a reverse button, which appeared on every screen in which one could reverse to a previous node. Therefore, all level-1 and level 2 nodes had a reverse button. While a subject was reading, the software kept track of the node and time spent on the node.

Place Figure 2 about here

In summary, the software recorded the follow data: traversal paths, time spent on each node including Questions, responses to questions, and any revisions of responses.

Analysis

The data consisted of responses to three questions, traversal paths, time spent in hypertext nodes, and time spent at Questions. Each question had two parts and each part was judged for its accuracy. For responses to questions, then, one could obtain a score from 0 (no part of any question was correct) to 6 (each part of all questions were correct). Traversal path information takes the form of a list of nodes selected by a subject. A subject's traversal-path list can be compared to an ideal path: one that goes to only important, information-laden nodes. A measure of efficient information access is the ratio of the selected Level-2 nodes of the ideal path (Level2-Hits) to the sum of those nodes plus other Level-2 nodes (Level2-Hits plus Misses). This Access Ratio is 1 if no extraneous nodes are selected and less than 1 otherwise. The Access Ratio does not take into account very well readers who briefly inspect a node that is not on the ideal traversal path and then quickly move on (peekers). Each brief visit to a node of this kind is as potent as a longer visit. Another measure of efficiency that avoids the problem of peekers is the ratio of time spent on important nodes to the sum of time on important and unimportant nodes. Here, important nodes include Level-1 and Level-2 nodes when they are on a traversal path leading to information that is important to answer a question. Unimportant nodes are Level-1 and Level-2 nodes that are not on an important traversal path. Again, this Time Ratio is 1 if time is spent on only important nodes and less than 1 as more time is spent on unimportant nodes.

Results

Results will be presented in the following order: Score information, efficiency information (Access Ratio and Time Ratio), and information regarding more and less correctly answered questions and their respective traversal paths. Following these data, additional data are presented that compare actual and predicted results of the Guthrie and Mosenthal Model (1987).

The task of reading a hypertext was difficult for many of the subjects. The modal Score was 0 and the mean Score was 1.9 (SD = 1.83) out of a possible Score of 6. In ratios, 11/30 (37%) subjects had a Score of 0, 19/30 (63%) had a Score below 3, and 7/30 (23%) had a Score above 3.

Access Ratio and Time Ratio data were computed for each subject. Access Ratios ranged from a low of 0.0 to a high of 0.86. Time Ratio data ranged from a low of 0.0 to a high of 0.97. Level2-Hits correlated with Score: $r = .75$.

Questions, mean Score, and traversal path are presented in Table 2. As expected, the question with the least complicated traversal path had the highest mean Score (Question 1) and the question with the most complicated traversal path had the lowest mean Score (Question 2).

Place Table 2 about here

There were five Level-1 nodes that contained part of an answer or led to a Level-2 node that did. The remaining five Level-1 nodes were unimportant to question answering. The Level-1 nodes labeled "Relativity" and "Particles" were unimportant nodes accessed at least once by half of the subjects (15/30). Other frequently visited, yet unimportant nodes, were Penthouse (9/30) followed closely by "Amyotrophic Lateral Sclerosis" (8/30) and "Origins of the Universe" (6/30). "Relativity" may have led many subjects astray because of its association with a reference to Einstein in Question 1. "Particles" was accessed often, perhaps, because Question 2 dealt with gravity and light. Subjects that had some prior knowledge regarding the wave-particle duality of light, might find the Level-1 node "Particles" appealing.

Subjects might have depth-first or breadth-first strategies to find important information in the hypertext. These two strategies correspond to spending relatively more search time in Level-2 (depth) or Level-1 (breadth) nodes. Going to relatively more Level-2 nodes would be a depth-first strategy, whereas, going to relatively more Level-1 nodes would be a breadth-first

strategy. The mean frequency of Level-2 node access was 5.23, SD = 4.51. The mean frequency of Level-1 node access was 4.17, SD = 2.52. These means are not directly comparable because there were twice as many Level-2 nodes as Level-1 nodes due to the binary-tree structure. In addition, five of the six important nodes for answering questions were at Level 2. Because most of the important information was in Level-2 nodes, a depth-first search strategy is preferable to a breadth-first search strategy. One would expect that depth-first searchers would have a higher Score than breadth-first searchers.

To see if depth-first searchers were better than breadth-first searchers on Score, one can compare Level-1 node access and Score at different important Level-2 node access (Level2-Hits). Specifically, one can look at Level-1 node access and Score when a subject has many Level2-Hits or few Level2-Hits. Many Level2-Hits is defined as more than the median number of Level2-Hits where the median is 2. Few Level2-Hits is defined as the median number or fewer Level2-Hits. The correlation of Score and Level-1 access when Level2-Hits are many is .64 and when Level2-Hits are few is .38. These correlations taken together can be interpreted in the following way: For those subjects who have many Level2-Hits, more Level 1 accesses is correlated with a higher Score (see Figure 3a). But for those with few Level2-Hits (breadth-first searchers), a few (3 or 4) Level-1 accesses leads to a higher Score, but many (more than 4) Level-1 accesses leads to a poorer Score. Figure 3b demonstrates the inverted U-shaped curve that results when subjects spend too much of their search time at Level 1 to the detriment of Level 2 and, thus, to the detriment of their Score.

Insert Figure 3 about here

In their search model, Guthrie and Mosenthal (1987) made predictions about good search strategies. The first was that good searchers would spend time and energy in goal formation. Two estimates of goal formation obtained from these data are (a) the number of times a subject returned to Question before attempting the first answer and (b) the time spent in Question before attempting the first answer. These estimates of goal formation take into account the time it took a reader to choose one of the three questions to answer, begin searching the hypertext, and, perhaps, change questions one or more times. No data were collected on the exact nature of the time spent before the first answer was attempted. The mean frequency of Question return was 4.2 (SD = 3.4). The distribution was normal except for three outlying cases who had frequencies greater than 9. The mean time in seconds spent in Question before attempting an answer was 128.7 (SD = 74.9). This distribution was skewed slightly toward the high end. Score correlated with the mean frequency of Question return -0.05 and with time spent on Question before attempting an answer -0.30. These data do not support the goal formation portion of the model.

A second prediction of the Model was that good searchers will integrate their newly-acquired knowledge by revising their responses as new information is found from a text. The mean frequency of answer revision was 1.0 (SD = 1.3). The distribution of answer revision was positively skewed. The correlation of answer revision with Score was r = .44 and increased to r = .64 for Subjects whose Score was above the median. Of those Subjects who revised their responses, seven had a Score above the median (greater than 2). These data are consistent with the Model.

The Model also predicted that subjects would reinspect the question and their responses as a checking procedure. The mean frequency of answer checking was 5.4 (SD = 4.38). The distribution of answer checking had a slight positive skew. Answer checking correlated with Score r = .18. These data do not support the Model.

Discussion

Adults who read a hypertext on Stephen Hawking—cosmologist and victim of Amyotrophic Lateral Sclerosis—found it difficult to answer three two-part questions. The more successful readers chose important text nodes more often and read them relatively longer than unsuccessful readers. In addition, questions posed to the hypertext readers

differed in difficulty as a direct result of the complexity of their traversal paths. Readers who adopted a depth-first search strategy were more successful than readers who used a breadth-first search strategy.

These results can be discussed in terms of the structure of text, the nature of text-based questions, and models of text search. When readers know more about the structure of a text they are able to comprehend and recall more information from it. Readers, in general, are unfamiliar with the new form of text: hypertext. Readers in this study had difficulty knowing where to find information and many could not answer any part of the three questions. Hypertext is naturally ill structured because it links multiple texts that each have a different structure. Spiro & Jehng (1990) argue as part of cognitive flexibility theory that ill structured domains should be attacked only after one has "superficial familiarity" with the concepts and facts of a domain. This argument would protect novices from hypermedia. However, readers might learn to search a particular hypertext using specific strategies to help them (e.g., using the known structure of the hypertext to combine important concepts) . In addition, they might learn general strategies for searching novel hypertexts. These general strategies might follow the Qin and Simon (1990) general problem-solving model, the Guthrie and Mosenthal (1987) text-search model, or the simple model that combines depth-first search and selectivity.

Questions of a text can range from very simple where the answer is found in a single part of the text to very complex where multiple parts of the answer are in different places in the text. Computer-based systems can be very helpful in answering simple questions. If a key word in a question can be searched using a computer-based Find tool, then the answer can be speedily and accurately found. For complex questions of complex hypertext, the benefit of computer-based systems is not as clear. Although various combinations of query languages and embedded links have been used to help readers find information in hypertext, it is still unclear if readers can make good use of these tools. The present data show that readers can range from not getting to any Level-1 nodes to finding every answer efficiently in the important Level-2 nodes. The question remains whether we can find a good combination of strategy instruction and hypertext interface necessary to increase the benefit of hypertext for more readers.

Perhaps, as some have argued (Barrett, 1991; Computers and the Human Conversation, 1991) the main benefit of hypertext is not in the reading and searching, but rather in the writing of hypertext. In writing and responding to hypertext one actively engages the textbase, which represents the writing of other persons who have engaged the same textbase. What develops is a "society of text" (Barrett, 1991). Imagine a class of fifth-graders writing about recycling in the community. Each person enters a contribution and links it with other relevant contributions in the growing textbase. This textbase is then offered to another class of children in another community with different recycling customs. Each new round of activity with the textbase (hypertext) engages the children anew as they read nodes in order to write new nodes to connect to existing ones.

In the present study, the search strategies that readers used to find answers to questions made a difference in their Score. In terms of the Hawking hypertext and the questions asked of it, using a breadth-first search strategy has limited payoff. The inverted U-shaped curve in Figure 3b depicts the necessary, but insufficient nature of searching too many Level-1 nodes. The more efficient strategists and better question answerers viewed a few selective Level-1 nodes, but concentrated on viewing important Level-2 nodes. Readers who were not strategic followed some of the same unsuccessful strategies that Qin and Simon (1990) attributed to unsuccessful problem solving.

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Table 1
Level-1 and Level-2 Nodes Arranged by Importance to the Questions

Level	Important Nodes in **Bold**	Unimportant Nodes
1	**Grand Unification Theory**	Amyotrophic Lateral Sclerosis
2	**Quantum Mechanics**	Terminal State
2	Uncertainty Principle	Other Problems
1	**Black Holes**	Penthouse
2	**Wave-Particle Duality**	Guccioni
2	Life Cycle of the Star	Keating
1	**Gravity**	Relativity
2	**Force**	Newton
2	Rate of Falling Bodies	Speed of light
1	**Private Eye**	Origins of the Universe
2	**Editors of Private Eye**	Catholic Church
2	**Outrageous Gossip**	Questions Remain
1	**Quantum Mechanics**	Particles
2	Determinism	Atoms
2	Uncertainty Principle	Interference

Table 2
Questions, Mean Score and Standard Deviation, and Traversal Paths

Q1 The theory of _____, which Einstein refused to believe, was proposed by _____ and is important to unification.
Mean = 0.80 SD = 0.91 Range = 0-2
Path Information
Level
0 Paragraph 1
1 Grand Unification Theory
2 Quantum Mechanics
0 Paragraph 2
1 Quantum Mechanics

Q2 Newton studied both gravity, a(n) _____ of attraction, and light, which he conceived of as _____, not waves.
Mean = 0.47 SD = 0.72 Range = 0-2
Path Information
Level
0 Paragraph 3
1 Black Holes
2 Wave/Particle Duality
1 Gravity
2 Force
Paragraph 5
1 Particles

Q3 _____, the editor of Private Eye, edited the outrageous publication, _____, previously.
Mean = 0.53 SD = 0.71 Range = 0-2
Path Information
Level
0 Paragraph 4
1 Private Eye
2 Editors
2 Gossip

Figure Captions

Figure 1. Four views of the questions screen

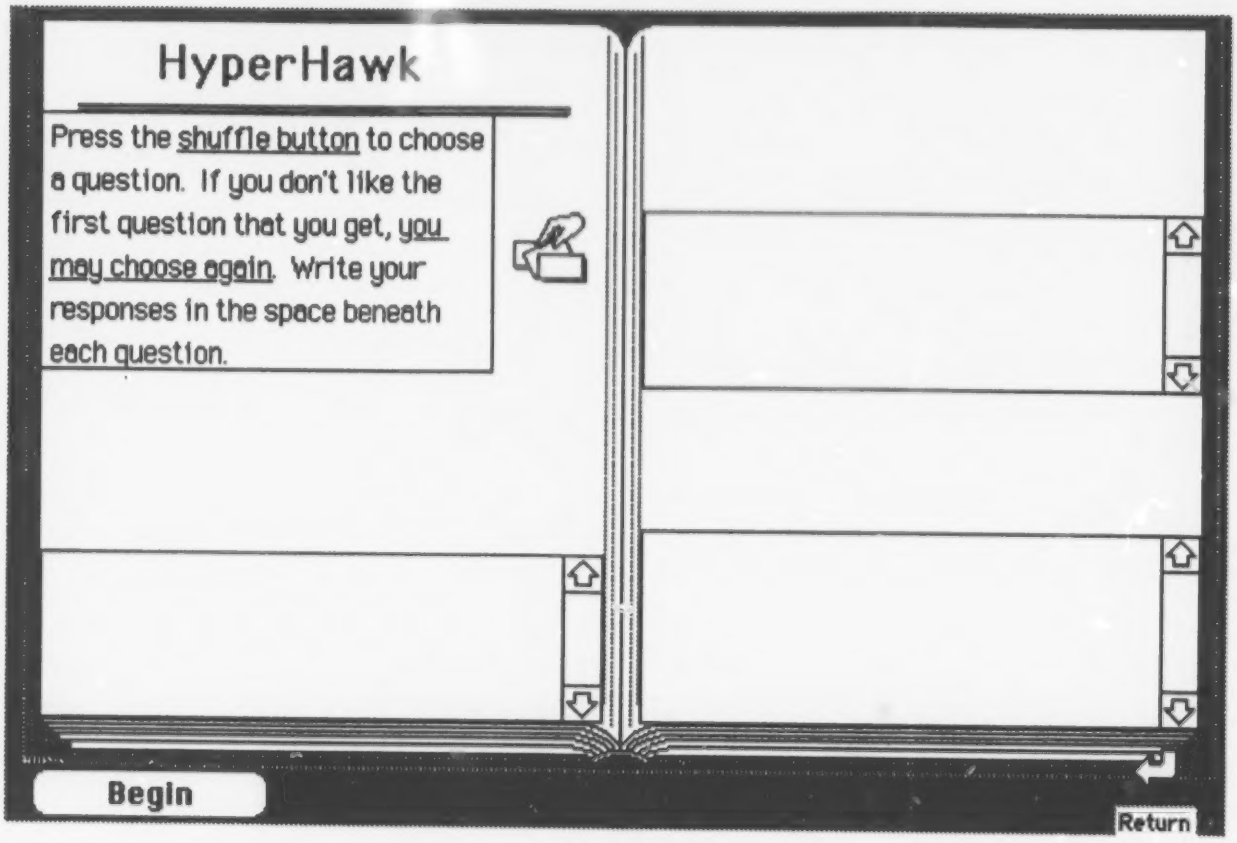

HyperHawk
Press the shuffle button to choose a question. If you don't like the first question that you get, you may choose again. Write your responses in the space beneath each question.
Begin
Return

Figure 1a. Questions screen

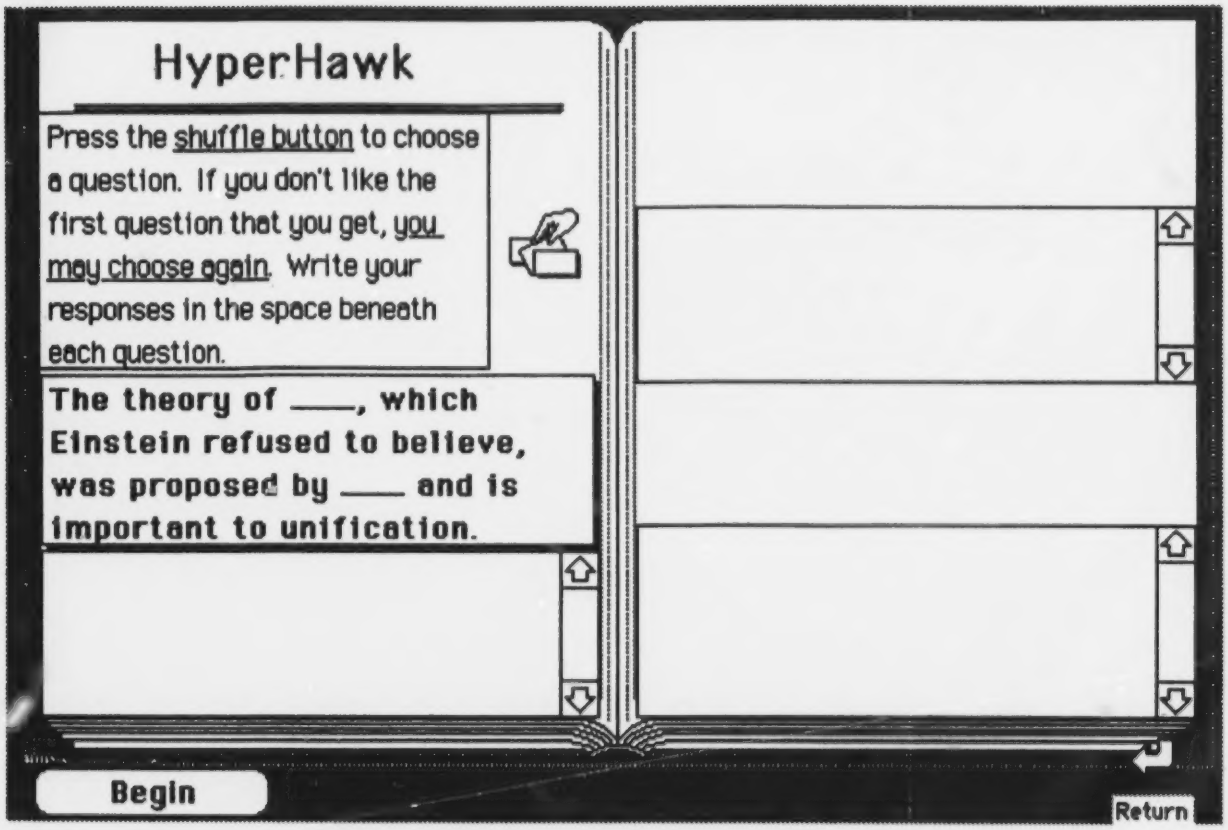

HyperHawk
Press the shuffle button to choose a question. If you don't like the first question that you get, you may choose again. Write your responses in the space beneath each question.
The theory of ____, which Einstein refused to believe, was proposed by ____ and is important to unification.
Begin
Return

Figure 1b. Question 1

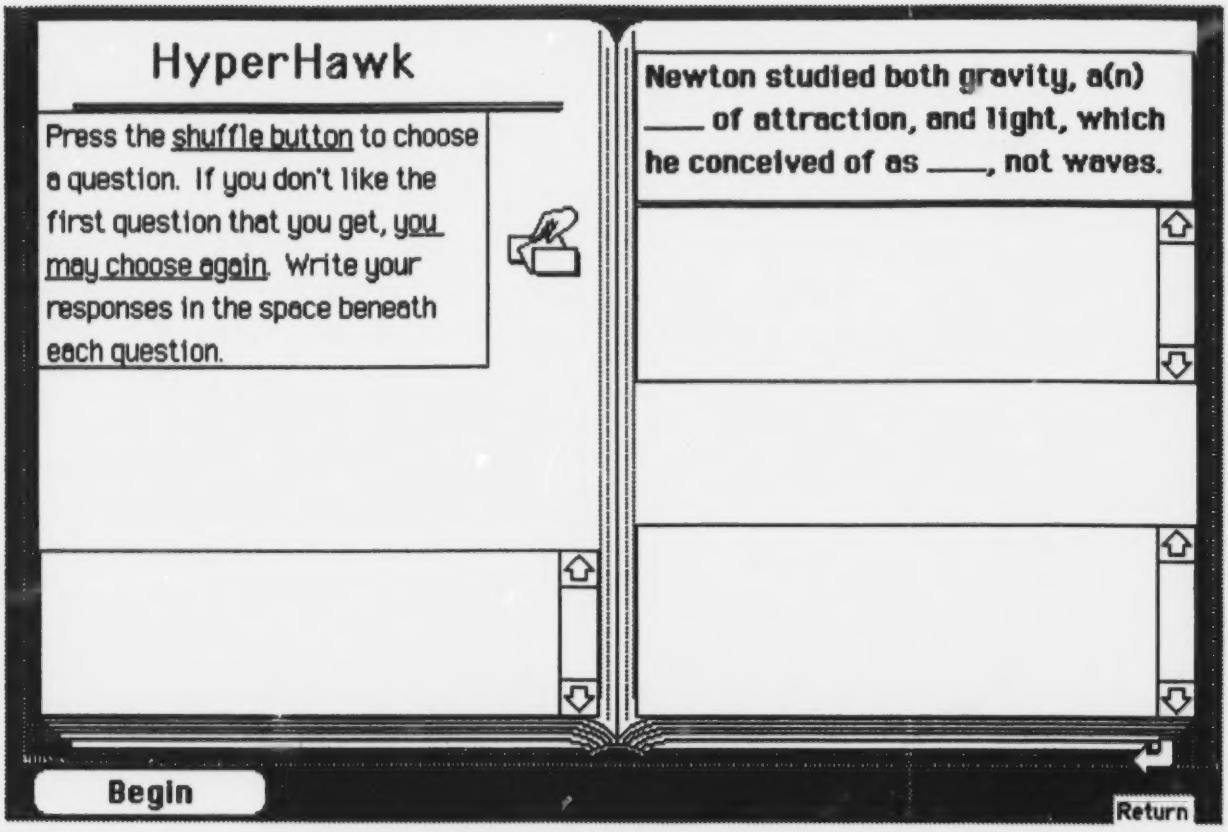

HyperHawk
Press the shuffle button to choose a question. If you don't like the first question that you get, you may choose again. Write your responses in the space beneath each question.
Newton studied both gravity, a(n) ____ of attraction, and light, which he conceived of as ____, not waves.
Begin
Return

Figure 1c. Question 2

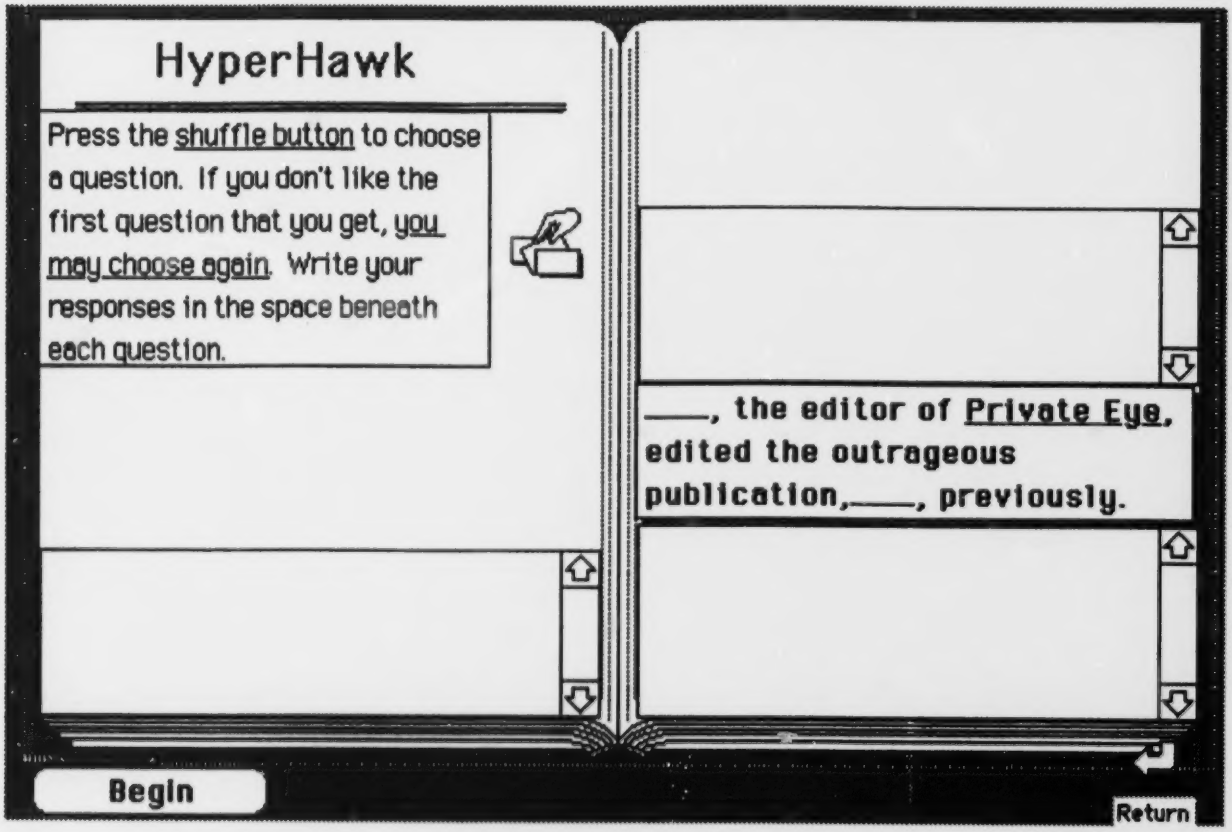

HyperHawk
Press the shuffle button to choose a question. If you don't like the first question that you get, you may choose again. Write your responses in the space beneath each question.
____, the editor of Private Eye, edited the outrageous publication,____, previously.
Begin
Return

Figure 1d. Question 3

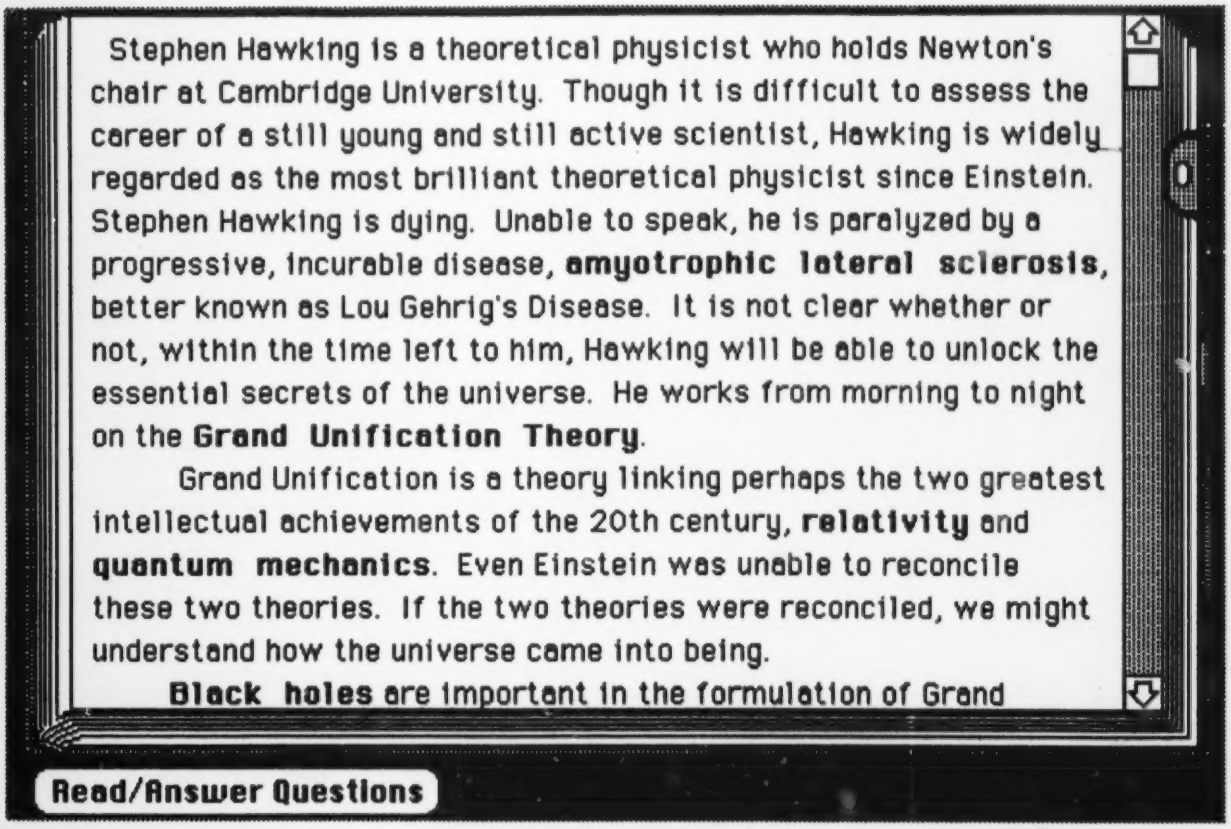

Stephen Hawking is a theoretical physicist who holds Newton's chair at Cambridge University. Though it is difficult to assess the career of a still young and still active scientist, Hawking is widely regarded as the most brilliant theoretical physicist since Einstein. Stephen Hawking is dying. Unable to speak, he is paralyzed by a progressive, incurable disease, amyotrophic lateral sclerosis, better known as Lou Gehrig's Disease. It is not clear whether or not, within the time left to him, Hawking will be able to unlock the essential secrets of the universe. He works from morning to night on the Grand Unification Theory.
Grand Unification is a theory linking perhaps the two greatest intellectual achievements of the 20th century, relativity and quantum mechanics. Even Einstein was unable to reconcile these two theories. If the two theories were reconciled, we might understand how the universe came into being.
Black holes are important in the formulation of Grand
Read/Answer Questions

Figure 2a. Sample hypertext screens featuring a path from a Level 0 node (paragraph 1) to a Level 1 node (amyotrophic lateral sclerosis)

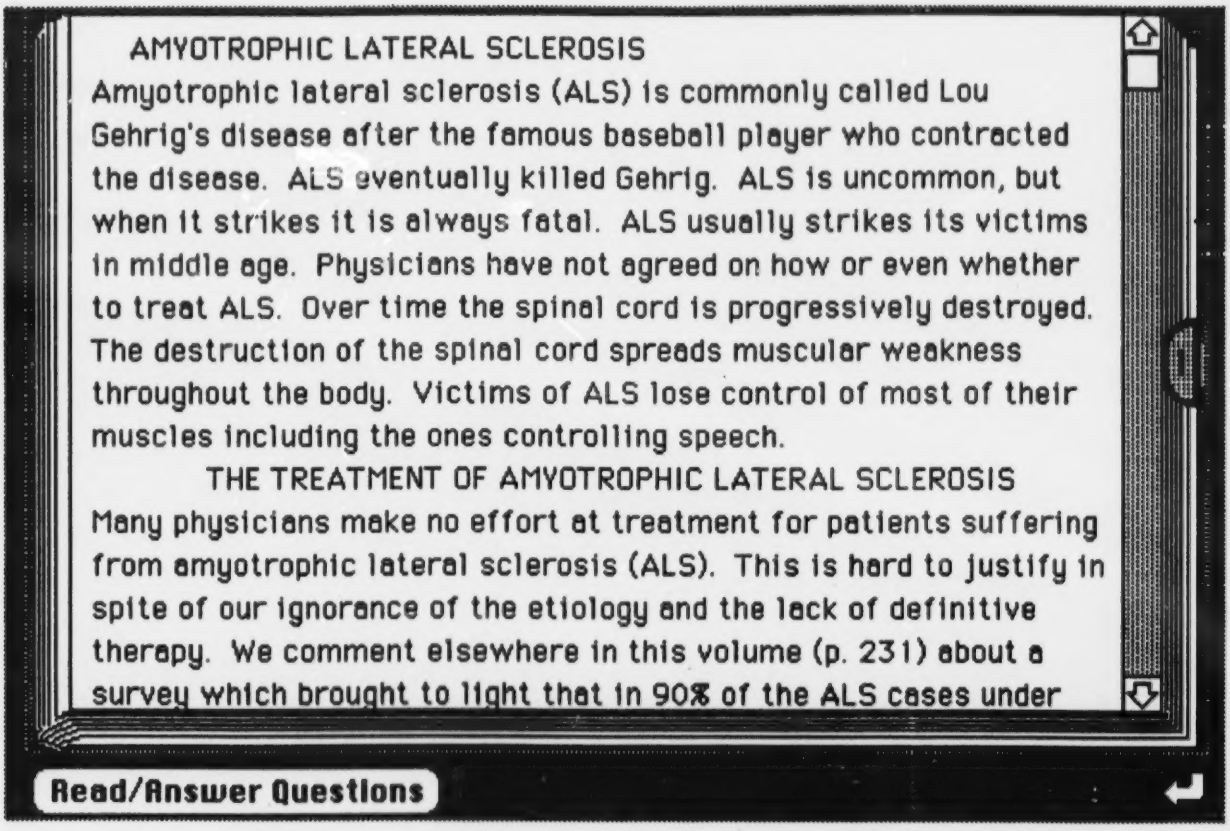

AMYOTROPHIC LATERAL SCLEROSIS
Amyotrophic lateral sclerosis (ALS) is commonly called Lou Gehrig's disease after the famous baseball player who contracted the disease. ALS eventually killed Gehrig. ALS is uncommon, but when it strikes it is always fatal. ALS usually strikes its victims in middle age. Physicians have not agreed on how or even whether to treat ALS. Over time the spinal cord is progressively destroyed. The destruction of the spinal cord spreads muscular weakness throughout the body. Victims of ALS lose control of most of their muscles including the ones controlling speech.
THE TREATMENT OF AMYOTROPHIC LATERAL SCLEROSIS
Many physicians make no effort at treatment for patients suffering from amyotrophic lateral sclerosis (ALS). This is hard to justify in spite of our ignorance of the etiology and the lack of definitive therapy. We comment elsewhere in this volume (p. 231) about a survey which brought to light that in 90% of the ALS cases under
Read/Answer Questions

Figure 2b. Level 1 node (amyotrophic lateral sclerosis)

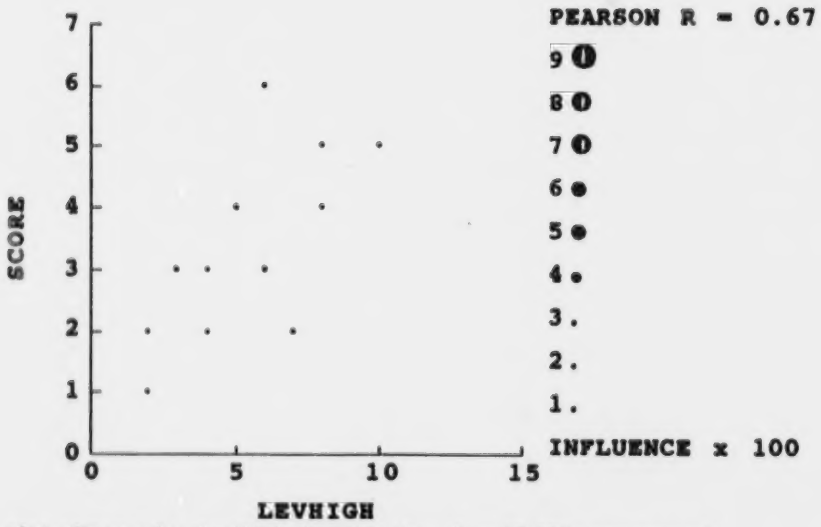
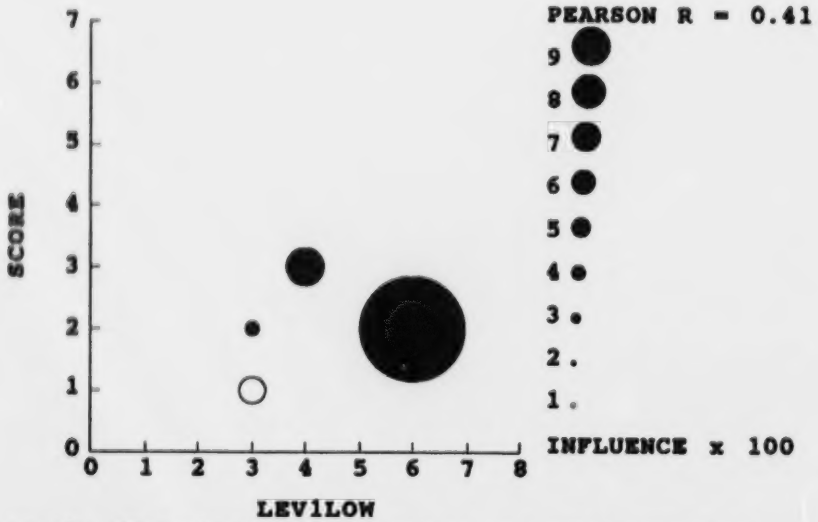


Figure 3a. Influence plot of Score by LevHigh (Level1 when Level2-Hits are many)



3b. Influence plot of Score by Level1Low (Level1 when Level2-Hits are Few)